(3)

* NOTICES *

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(19) [Publication country] Japan Patent Office (JP)
(12) [Kind of official gazette] Patent official report (B-2)
(11) [Patent number] Patent No. (P3160099) 3160099
(24) [Registration date] February 16, Heisei 13 (2001. 2.16)
(45) [Publication date] April 23, Heisei 13 (2001. 4.23)
(54) [Title of the Invention] The manufacture approach of a heat exchanger
(51) [The 7th edition of International Patent Classification]

B23K 1/00 330
1/20

[FI]

B23K 1/00 330 J
1/20 F

[The number of claims] 3
[Number of Pages] 3
(21) [Application number] Japanese Patent Application No. 4-332075
(22) [Filing date] December 11, Heisei 4 (1992. 12.11)
(65) [Publication No.] JP,6-179072,A
(43) [Date of Publication] June 28, Heisei 6 (1994. 6.28)
[Request-for-examination day] August 31, Heisei 11 (1999. 8.31)
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(58) [The investigated field] (Int.Cl.7, DB name)
B23K 1/00 330
B23K 1/20

[Translation done.]

* NOTICES *

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CLAIMS

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(57) [Claim(s)]
[Claim 1] The manufacture approach of a heat exchanger characterized by providing the following. The extrusion-molding process which carries out extrusion molding of the tube The cooling process which cools the tube of the shape of a long picture acquired according to the extrusion-molding process at 0-100 degrees C The spreading process by which

the coating of the metal which presents the sacrificial anode effectiveness on a long picture-like tube front face, an aluminum-Si system alloy, and the constituent for soldering containing binder resin is applied after a cooling process The cutting process which cuts a long picture-like tube to predetermined die length after a spreading process, and the soldering process which combines the predetermined tube and predetermined fin of die length after a cutting process, and is soldered
[Claim 2] The manufacture approach of the heat exchanger of claim 1 characterized by the coating of the metal which presents the sacrificial anode effectiveness applied on a long picture-like tube front face after a cooling process, an aluminum-Si system alloy, and the constituent for soldering containing binder resin being a coating of the constituent for soldering containing aluminum-Si-Zn system alloy powder and binder resin.
[Claim 3] The manufacture approach of the heat exchanger of claim 1 characterized by the coating of the metal which presents the sacrificial anode effectiveness applied on a long picture-like tube front face after a cooling process, an aluminum-Si system alloy, and the constituent for soldering containing binder resin being a coating of the constituent for soldering containing aluminum-Si-Zn system alloy powder, binder resin, and flux.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the capacitor of for example, the radiator for automobiles, or an air-conditioner, and the heat

exchanger used as an evaporator.
[0002]
[Background of the Invention] Conventionally, wax material constitutes tubing (tube) and a fin from a brazing sheet by which the clad was carried out, and the heat exchanger made from aluminum or an aluminium alloy (the following, aluminium alloy) assembles these in a predetermined configuration, and is manufactured by soldering.
[0003] By the way, since the heat exchanger made from an aluminium alloy constituted using the brazing sheet is covered by the wax material which the whole front face becomes from an aluminum-Si system alloy etc., the wax material fused, for example may eat a base material away, the reinforcement of a fin or a tube may fall remarkably, and deformation may produce it. Then, the coating of the constituent for soldering which comes to mix the binder resin which is easy to volatilize rather than it carbonizes at aluminum-Si system alloy powder and soldering temperature is applied on the surface of a tube, and the heat exchanger which it comes to solder by heat-treating is proposed.
[0004]
[Description of the Invention] By the way, although the technique of said proposal was extremely excellent as compared with the technique of an old heat exchanger and it was exposed to praise, it was sometimes admitted that a problem was sometimes in heat exchange effectiveness. As a result of pushing the research on this trouble wholeheartedly and performing it, it is spreading on the tube front face of the constituent coating for soldering, Since it was carried out after being cut by the predetermined die length which needs a long picture-like tube until now and the circulation of a refrigerant itself fell when the applied coating itself sometimes closes some opening holes of a tube edge and it was such, it came to acquire the knowledge whether a problem occurs in heat exchange effectiveness.
[0005] This invention is attained based on such knowledge, and the purpose of this invention is that excel in heat exchange effectiveness and manufacture efficiency also offers a high technique. The purpose of above-mentioned this invention is an extrusion-molding process which carries out extrusion molding of the tube, The cooling process which cools the tube of the shape of a long picture acquired according to the extrusion-molding process at 0-100 degrees C, The spreading process by which the coating of the metal which presents the sacrificial anode effectiveness on a long picture-like tube front face, an aluminum-Si system alloy, and the constituent for soldering containing binder resin is

applied after a cooling process, It is attained by the manufacture approach of the heat exchanger characterized by providing the cutting process which cuts a long picture-like tube to predetermined die length after a spreading process, and the soldering process which combines the predetermined tube and predetermined fin of die length after a cutting process, and is soldered.

[0006] In addition, as for the coating of the metal which presents the sacrificial anode effectiveness applied on a long picture-like tube front face after a cooling process, an aluminum-Si system alloy, and the constituent for soldering containing binder resin, it is desirable that it is the coating of the constituent for soldering containing aluminum-Si-Zn system alloy powder and binder resin, and it is much more desirable that it is a thing containing aluminum-Si-Zn system alloy powder, binder resin, and flux.

[0007] That is, the trouble of having sometimes occurred is a long picture [since it originated in having been carried out to the tube after spreading of the constituent coating for soldering was cut by predetermined die length]-like tube, and an extrusion-molding process. A revelation that what is necessary will be just to probably apply to the tube of the shape of an acquired long picture itself was obtained, when carrying out like **, the above-mentioned trouble was solved, and the heat exchanger excellent in heat exchange effectiveness was obtained.

[0008] Moreover, when spreading of the constituent coating for soldering is performed to the tube of the shape of a long picture immediately after extrusion molding, it is, The paint film of the constituent for soldering is not formed good, but curse between fins, and condition is unsatisfactory. As a result of carrying out by pushing the research on this, from it having been satisfactory when the temperature at the time of spreading was low As for spreading of the constituent coating for soldering, it was important to have carried out, after the tube of the shape of a long picture acquired according to the extrusion-molding process is cooled, and when carrying out like **, the trouble of soldering nature was solved. For example, cooling temperature is [that about 300-600 degrees C of tubes after an extrusion-molding process should just usually cool a **** and this with proper means, such as water cooling, Myst, and air cooling,] about room temperature -60 degree C preferably that what is necessary is just about 0-100 degrees C.

[0009] Moreover, if it carries out while spreading of the constituent coating for soldering has been a long picture-like, the spreading itself can be performed efficiently and it is so advantageous also in respect of

cost. As for the mean particle diameter of the metal powder of the constituent for soldering used by this invention, for example, aluminum-Si-Zn system alloy powder, it is desirable that it is 10-200 micrometers. That is, it is because the amount of the flux used used for the oxide film removal at the time of soldering since surface area is remarkable and large as the mean particle diameter of the constituent for soldering is less than 10 micrometers also increases, the fluidity when adding binder resin becomes small and spreading becomes difficult, and conversely, if the mean particle diameter of the constituent for soldering becomes large too much exceeding 200 micrometers, it will become that the spreading itself is difficult, and will become difficult in the junction activity itself. Mean particle diameter is 10-100 micrometers much more preferably.

[0010] And it is because Zn has a **** property electrochemically, so the sacrificial anode effectiveness is done so and the anti-corrosiveness of a fin or a tube becomes high to have made Zn contain for example. Polyacrylic acid butyl etc. is mentioned that what is necessary is just acrylic resin which is easy to volatilize as binder resin rather than it carries out decomposition carbonization at soldering temperature and whose molecular weight is 1000 to about 100000.

[0011] and soldering -- public funds -- the blending ratio of coal of group powder and binder resin -- soldering -- public funds -- group powder / binder resin -- a weight ratio -- 1000 / 1 - 1/1 -- it is 20 / 1 - 2/1 still more preferably. As flux, they are KF-AlF3 and RbF-AlF3, for example. Although there is a thing of a chloride system like the thing of a fluoride system [like], KCl-LiCl-NaF, CaCl2-KCl-ZnCl2, NaCl-KCl-LiCl-LiF-ZnCl2, and ZnCl2-NaF-NH4Cl, various kinds of things are used. In addition, the thing of a fluoride system is much more desirable.

[0012] And the viscosity of the constituent at the time of spreading is good to be in the range of 10cP-100cP. It is because it is difficult for a fluidity to be large, and for powder not to adhere [viscosity] good in the following condition 10 cPs, and for viscosity to apply to a front face in 100 or more cPs that there is no nonuniformity in homogeneity. As a spreading means of the constituent for soldering, although a spray method, the flow coater method, etc. are mentioned, it is not restricted to this. That is, as long as it is the method of application which can be applied to a long picture-like thing, what kind of thing may be used.

[0013] As for film thickness, it is desirable that the thickness after desiccation is about about 10-200 micrometers. And as the heat treatment approach for soldering, various means, such as soldering

under a vacuum ambient atmosphere and an inert atmosphere, are employable suitably. Hereafter, an example explains this invention concretely.

[0014]

[Example]

[Example 1] After producing the tube made from aluminum with a width of face [of 20mm], and a thickness of 2mm with a hot extrusion means, water was made into the shape of a fog, and was sprayed on the tube made from aluminum of the shape of this long picture, and skin temperature of the tube made from aluminum was made into 40 degrees C.

[0015] Then, predetermined thickness spreading was carried out with the spray method, and the long picture-like tube front face made from aluminum was made to dry the alcoholic solution which mixed alloy powder with a mean particle diameter of 30**15 micrometers which made JIS4343 alloy contain 4wt(s)% Zn, and acrylic resin. Then, the long picture-like tube made from aluminum was cut to predetermined die length, it assembled with the fin, and fluoride system flux was applied to the joint.

[0016] And under nitrogen-gas-atmosphere mind, it soldered by having heat-treated for about 3 minutes at 600 degrees C, and considered as the heat exchanger made from an aluminium alloy.

[Example 2] Set in the example 1, and skin temperature of the tube made from aluminum before spreading was made into 20 degrees C, and also it carried out similarly, and the heat exchanger made from an aluminium alloy was obtained.

[0017] [Example 3] The tube made from aluminum with a width of face [of 20mm] and a thickness of 2mm was extruded with the hot extrusion means, and it twisted around the iron core, and coiled, and coil skin temperature was made into 40 degrees C by natural radiationnal cooling. Then, it carried out like the example 1 and the heat exchanger made from an aluminium alloy was obtained.

[0018] [Example 1 of a comparison] In the example 1, spreading was performed immediately after extrusion between heat (skin temperature is 450 degrees C), and also it carried out similarly, and the heat exchanger made from an aluminium alloy was obtained.

[Example 2 of a comparison] In the example 1, after cutting long picture-like the tube made from aluminum to predetermined die length, spreading was performed, and also it carried out similarly, and the heat exchanger made from an aluminium alloy was obtained.

[0019]
[Property] Since the property of the heat exchanger obtained in the above-mentioned examples 1-3 and the examples 1 and 2 of a comparison was investigated, the result is shown in Table 1.
Table 1 Lock out of the hole of a tube Junction condition with a fin Workability example 1 0/1000 Fitness The good example 2 0/1000 Fitness The good example 3 0/1000 Good Example 1 of a good comparison 0/1000 Defect Example 2 of a good comparison 100/1000 Good [poor] [0020]
[Effect] According to this invention, heat exchange effectiveness is good, and the junction condition of a fin and a tube is also good, and it excels also in workability, and a cheap heat exchanger is obtained efficiently.

[Translation done.]

(3)

書誌

(19)【発行国】日本国特許庁(JP)
(12)【公報種別】特許公報(B2)
(11)【特許番号】特許第3160099号(P3160099)
(24)【登録日】平成13年2月16日(2001. 2. 16)
(45)【発行日】平成13年4月23日(2001. 4. 23)
(54)【発明の名称】熱交換器の製造方法
(51)【国際特許分類第7版】

B23K 1/00 330
1/20

【FI】

B23K 1/00 330 J
1/20 F

【請求項の数】3
【全頁数】3
(21)【出願番号】特願平4－332075
(22)【出願日】平成4年12月11日(1992. 12. 11)
(65)【公開番号】特開平6－179072
(43)【公開日】平成6年6月28日(1994. 6. 28)
【審査請求日】平成11年8月31日(1999. 8. 31)
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(58)【調査した分野】(Int. Cl. 7, DB名)
B23K 1/00 330
B23K 1/20

請求の範囲

(57)【特許請求の範囲】
【請求項1】チューブを押し出し成形する押し出し成形工程と、押し出し成形工程によって得られた長尺状のチューブを0～100℃に冷却する冷却工程と、冷却工程後に、長尺状のチューブ表面に犠牲陽極効果を呈する金属、Al－Si系合金、及びバインダ樹脂を含むろう付け用組成物の塗料が塗布される塗布工程と、塗布工程後に、長尺状のチューブを所定の長さに切断する切断工程と、切断工程後に、所定の長さのチューブとフィンとを組み合わせ、ろう付けするろう付け工程とを具備することを特徴とする熱交換器の製造方法。
【請求項2】冷却工程後に長尺状のチューブ表面に塗布される犠牲陽極効果を呈する金属、Al－Si系合金、及びバインダ樹脂を含むろう付け用組成物の塗料が、Al－Si－Zn系合金粉末及びバインダ樹脂を含むろう付け用組成物の塗料であることを特徴とする請求項1の熱交換器の製造方法。
【請求項3】冷却工程後に長尺状のチューブ表面に塗布される犠牲陽極効果を呈する金属、Al－Si系合金、及びバインダ樹脂を含むろう付け用組成物の塗料が、Al－Si－Zn系合金粉末、バインダ樹脂及びフラックスを含むろう付け用組成物の塗料であることを特徴とする請求項1の熱交換器の製造方法。

詳細な説明

【発明の詳細な説明】
【0001】
【産業上の利用分野】本発明は、例えば自動車用ラジエータやエアコンのコンデンサ、エバポレータとして用いられる熱交換器に関するものである。
【0002】
【発明の背景】従来、アルミニウム又はアルミニウム合金(以下、アルミニウム合金)製熱交換器は、ろう材がクラッドされたブレージングシートで管

(チューブ)やフィンを構成し、これらを所定の形状に組み立て、そしてろう付けすることにより製造されている。
【0003】ところで、ブレージングシートを用いて構成されたアルミニウム合金製熱交換器は、表面全体がAl－Si系合金等からなるろう材で覆われているので、例えば溶融したろう材が母材を侵食し、フィンやチューブの強度が著しく低下し、変形が生じることがある。そこで、Al－Si系合金粉末とろう付け温度で炭化するよりも揮発し易いバインダ樹脂とを混合してなるろう付け用組成物の塗料をチューブの表面に塗布し、熱処理を施すことによりろう付けしてなる熱交換器が提案されている。
【0004】
【発明の開示】ところで、前記提案の技術はこれまでの熱交換器の技術に比較して極めて優れたものであり、称賛を浴びているものであったが、時として熱交換効率に問題の有ることが認められることも有った。この問題点についての研究を鋭意押し進めて行った結果、ろう付け用組成物塗料のチューブ表面への塗布は、これまで、長尺状のチューブが必要な所定の長さに切断された後に行われていた為、塗布された塗料自体がチューブ端の開口孔を多少塞ぐようになっていることが有り、このようになっていると冷媒の流通自体が低下することもあって、熱交換効率に問題が起きるのではないかとの知見を得るに至ったのである。
【0005】このような知見に基づいて本発明が達成されたものであり、本発明の目的は、熱交換効率に優れ、かつ、製造能率も高い技術を提供することである。上記本発明の目的は、チューブを押し出し成形する押し出し成形工程と、押し出し成形工程によって得られた長尺状のチューブを0～100℃に冷却する冷却工程と、冷却工程後に、長尺状のチューブ表面に犠牲陽極効果を呈する金属、Al－Si系合金、及びバインダ樹脂を含むろう付け用組成物の塗料が塗布される塗布工程と、塗布工程後に、長尺状のチューブを所定の長さに切断する切断工程と、切断工程後に、所定の長さのチューブとフィンとを組み合わせ、ろう付けするろう付け工程とを具備することを特徴とする熱交換器の製造方法によって達成される。
【0006】尚、冷却工程後に長尺状のチューブ表面に塗布される犠牲陽極効果を呈する金属、Al－Si系合金、及びバインダ樹脂を含むろう付け用組成物の塗料は、Al－Si－Zn系合金粉末及びバインダ樹脂を含むろう付け用組成物の塗料であることが好ましく、そしてAl－Si－Zn系合金粉末、バインダ樹脂及びフラックスを含むものであることが一層好ましい。
【0007】すなわち、時として起きていた問題点は、ろう付け用組成物塗料の塗布作業が所定の長さに切断された後のチューブに対して行われていたことに起因したことから、長尺状のチューブ、押し出し成形工程によって得られた長尺状のチューブそのものに対して塗布すれば良いであろうとの啓示が得られ、斯の如くにすれば前述の問題点が解決され、熱交換効

率に優れた熱交換器が得られたのである。
【0008】又、ろう付け用組成物塗料の塗布作業を押し出し成形直後の長尺状のチューブに対して行うと、ろう付け用組成物の塗膜が良好に形成されず、フィンとの間でのろう付け具合が思わしくなく、これについての研究が押し進められて行った結果、塗布時の温度が低い場合には問題がなかったことから、ろう付け用組成物塗料の塗布作業は押し出し成形工程によって得られた長尺状のチューブが冷却された後にすることが大事であり、斯の如くにすればろう付け性の問題点が解決されていたのである。例えば、押し出し成形工程後のチューブは、通常、300～600℃程度あり、これを水冷、ミスト、空冷などの適宜な手段により冷却すれば良く、そして冷却温度は0～100℃程度であれば良く、好ましくは室温～60℃程度である。
【0009】又、ろう付け用組成物塗料の塗布作業が長尺状のままで実施されると、塗布作業自体も効率良く行え、それだけコスト面でも有利である。本発明で用いられるろう付け用組成物の金属粉末、例えばAl－Si－Zn系合金粉末の平均粒径は10～200μmであるのが好ましい。すなわち、ろう付け用組成物の平均粒径が10μm未満であると、表面積が著しく大きいため、ろう付け時の酸化膜除去に使用されるフラックスの使用量も多くなり、バインダ樹脂を加えた時の流動性が小さくなって塗布作業が困難になるからであり、逆に、ろう付け用組成物の平均粒径が200μmを越えて大きくなり過ぎると、塗布自体が困難となり、又、接合作業自体も困難になってしまう。より一層好ましくは平均粒径が10～100μmのものである。
【0010】そして、例えばZnを含有させたのは、Znが電気化学的に卑な特性を有するため、犠牲陽極効果が奏されてフィンやチューブの防食性が高くなるからである。バインダ樹脂としては、ろう付け温度で分解炭化するより揮発し易い、分子量が1000～100000程度のアクリル系の樹脂であれば良く、例えばポリアクリル酸ブチル等が挙げられる。
【0011】そして、ろう付け用金属粉末とバインダ樹脂との配合割合は、ろう付け用金属粉末／バインダ樹脂が重量比で1000／1～1／1、更に好ましくは20／1～2／1である。フラックスとしては、例えばKF－AlF_3、RbF－AlF_3のような弗化物系のもの、KCl－LiCl－NaF、$CaCl_2$－KCl－$ZnCl_2$、NaCl－KCl－LiCl－LiF－$ZnCl_2$、$ZnCl_2$－NaF－NH_4Clのような塩化物系のものがあるが、その他にも各種のものが用いられる。尚、弗化物系のものが一層好ましい。
【0012】そして、塗布時における組成物の粘度は10cP～100cPの範囲にあることが良い。なぜなら、粘度が10cP以下のような状態では、流動性が大きく粉末が良好に付着せず、又、粘度が100cP以上では表面に均一にムラ無く塗布するのが難しいからである。ろう付け用組成物の

塗布手段としては、スプレー法、フローコーター法などが挙げられるが、これに限られることはない。すなわち、長尺状のものに塗布できる塗布方法であれば如何なるものでも良い。
【0013】塗膜厚は乾燥後の厚さが約10～200μm程度であることが好ましい。そして、ろう付けする為の熱処理方法としては、真空雰囲気下や不活性雰囲気下におけるろう付け等の様々な手段を適宜採用できる。以下、本発明を実施例により具体的に説明する。
【0014】
【実施例】
〔実施例1〕熱間押出手段により幅20mm、厚さ2mmのアルミニウム製チューブを作製した後、この長尺状のアルミニウム製チューブに水を霧状にして吹き付け、アルミニウム製チューブの表面温度を40℃にした。
【0015】この後、JIS4343合金に4wt%のZnを含有させた平均粒径30±15μmの合金粉末とアクリル系樹脂とを混合したアルコール溶液を長尺状のアルミニウム製チューブ表面にスプレー法により所定厚さ塗布し、乾燥させた。この後、長尺状のアルミニウム製チューブを所定の長さに切断し、フィンと組み立て、接合部に弗化物系フラックスを塗布した。
【0016】そして、窒素ガス雰囲気下において600℃で約3分間熱処理してろう付けを行い、アルミニウム合金製熱交換器とした。
〔実施例2〕実施例1において、塗布前におけるアルミニウム製チューブの表面温度を20℃にした他は同様に行い、アルミニウム合金製熱交換器を得た。
【0017】〔実施例3〕熱間押出手段により幅20mm、厚さ2mmのアルミニウム製チューブを押し出し、鉄コアに巻き付けてコイル化し、自然放冷によりコイル表面温度を40℃にした。この後、実施例1と同様に行ってアルミニウム合金製熱交換器を得た。
【0018】〔比較例1〕実施例1において、塗布作業を熱間押し出し直後（表面温度が450℃）に行った他は同様に行い、アルミニウム合金製熱交換器を得た。
〔比較例2〕実施例1において、長尺状のアルミニウム製チューブを所定の長さに切断した後に塗布作業を行った他は同様に行い、アルミニウム合金製熱交換器を得た。
【0019】
【特性】上記実施例1～3及び比較例1，2で得た熱交換器の特性を調べたので、その結果を表1に示す。
表 1 チューブの孔の閉塞 フィンとの接合具合 作業性実施例1 0／1000 良好 良好実施例2 0／1000 良好 良好実施例3 0／1000 良好 良好比較例1 0／1000 不良 良好比較例2 100／1000 良好 不良【0020】
【効果】本発明によれば、熱交換効率が良く、フィンとチューブとの接合具

合も良好であって、かつ、作業性にも優れ、低廉な熱交換器が効率良く得られる。